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Proximate Composition of Finger Millet (*Eleusine coracana*) in Regional areas of Maharashtra

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Abstract

Finger millet is amongst the major crops of Maharashtra. In several years there is decline of both production & consumption of millet. The sample of Finger millet were collected from regional places of Nashik and Kolhapur Maharashtra. Further these were taken for chemical composition and proximate analysis as sample one & sample two. The results were determined using the standard analytical methods and compared with the Indian Institute of Millet Research reports . The result of the chemical composition of different District of Maharashtra, Nashik (sample one) was found to be **Ca** (**363.87± 22.45**), Mg (96.0± 0.78), Fe (5.02± 0.12), Zn (1.74± 0.96), Cu (1.60± 0.09), **P** (**280.0± 9.78**) and Kolhapur (sample two) was found to be **Ca**(**362.28± 16.68**), Mg (97.04± 0.36), Fe (4.78± 0.43), Zn (1.46± 0.79), Cu (0.98± 0.41), **P** (**282.34± 7.64**). The Proximate analysis of sample one had crude protein (10.96 ± 0.520), crude fiber (5.45 ± 1.26), carbohydrate (72.48 ± 0.48), energy (347.03 ± 10) and sample two had crude protein (5.78 ± 0.894), crude fiber (8.56 ± 2.17), carbohydrate (64.96 ± 0.81), energy (318 ± 15). Both results of chemical composition and proximate analysis were comparable. These results shows finger millet can be rich source of Calcium and Phosphorous. These can be used as Calcium supplement food for and its composite flours of it can be used for preservation of various nutrient dense recepies which can be effectively used as supplement feeding program.

Keywords: Finger millet, chemical composition, proximate analysis, Calcium, Phosphorous.

1. Introduction

Millet is a generic term describing a range of small-seeded grains in two tribes Paniceae & Chlorideae of the family Poaceae. It became a staple food for humans 10,000 years ago already before the rise of wheat & rice.

Millet is important foods in many underdeveloped countries because of their ability to grow under adverse weather conditions like limited rainfall. Nutritional well being is a sustainable force for health, development & maximization of human genetic potential. The nutritional status of a community has therefore been recognized as an important indicator of national development. In other words, malnutrition is an impediment in national development & hence assumes the status of national problem. For solving the problem of deep-rooted food insecurity & malnutrition, dietary quality should be taken into consideration.

Finger millet is among the major crop of Maharashtra. Over the year there has been rapid decline both in production & consumption of Millets. Chemical composition of finger millet that total carbohydrate content of Finger millet has been reported to be in range of 72 to 79.5%[17]. Finger millet has nearly 7% protein but large variations in protein content from 5.6 to 12.70% have been reported by the various studies. Total ash content is higher in finger millet than in commonly consumed cereal grains. Calcium content of 36 genotypes of finger millet ranged from 162 to 487 mg %. (Singh & Srivastava, 2006)[15] reported the iron content of 16 Finger millet varieties ranged from 3.61 mg/100g to 5.42 mg%.

It is the richest source of Calcium (Ca) & Iron (Fe). Calcium deficiency leads to bone & teeth disorder, Iron deficiency leading to anemia can be overcome by using processing techniques like popping, roasting, malting & fermentation. The use of these techniques not only decrease the content of anti-nutrients but increase the bioavailability of the certain minerals like Calcium & Iron. Composite flours made by using finger millet can be used for preparation of various nutrient dense recipes which can effectively used for supplementary feeding programs.

2. Materials and Methods

2.1 Materials

Local finger millet seed were taken from market of district Nashik and Kolhapur, Maharashtra, India. The raw finger millet samples were placed in a tray which is placed in oven to dry at 40^0 C and the chaff and damaged grains as well as stones/pebbles etc. Extraneous matter were removed by hand and discarded. Milling of grains and extrudates to produce flour was carried out. After those process sample is kept in airtight glass bottle use for further analysis.

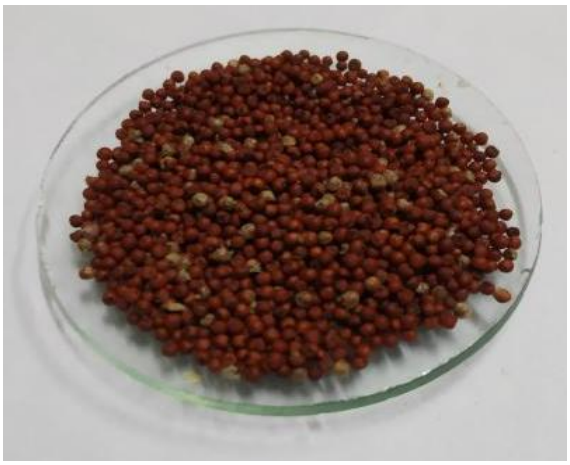
Sample No. 1 (*Nashik* region)	Sample No. 2 (*Kolhapur* region)
	

Fig.1 sample of Finger millet (*Eleusine coracana)*

2.2 Mineral analysis of sample for sample one and two

2.2.1 Estimation of calcium

Calcium can be estimated by the method described by (Piper, 1950)[13]. The silica-free solution of the cereal ash is neutralized with an acid and methyl red indicator solution. Then the calcium in the sample is converted to calcium oxalate precipitated by pH adjustment. The calcium content is then determined by titration of the calcium oxalate with standard potassium permanganate. Calculating the amount of Ca using the following relationship in the aliquot taken and express the results as mg/100g of plant sample.

1ml of 0.1N $KMnO_4$ = 4 mg of Ca or 5.8 mg of CaO

2.2.2 Estimation of magnesium

Magnesium can be estimated by the method of (Piper, 1950)[13]. It is determined by preparation as magnesium ammonium phosphate in the filtrate from the calcium preparation, citrate being used in solution. Finally, by multiplying as $Mg_2P_2O_7$ is weighed and converted into the Mg. The relation is as shown as below.

0.2184 × weight of $Mg_2P_2O_7$ = weight of Mg

2.2.3 Estimation of iron

Iron were determined by the method of (Lindsay and Norvell, 1978)[9]. The sample is wet ashed using H_2SO_4 , HNO_3 and $HClO_4$. An aliquot of the extract is treated with thioglycollic acid and the colour is read in a photometer at 535m. Calculating the amount of iron (ferric) form in the sample using the standard curve and express it as mg/100g of sample.

2.2.4 Estimation of zinc

Zinc can be determined by the method described by (Cowling and Miller, 1941)[3]. Colorimetrically based on the extraction of all dithizone metals from a solution of the sample, separation of zinc and other metals from copper by shaking with HCL and re-extraction of the zinc from this solution with dithizone and in the presence of sodium diethyldithiocarbamate which forms stable complex with all metals present except zinc so that in the second extraction with dithizone, zinc is the only metal which passes into the dithizone-carbontracholride phase. The colour intensity is red colorimetrically at 535cm. Calculating the amount of zinc in the aliquot sample using the standard curve and express the results as mg/100g of sample.

2.2.5 Estimation of copper

Copper can be determined by the method of (Callan and Henderson, 1929)[2]. The copper extracted from sample ash by wet oxidation method is treatment with sodium diethyldithiocarbamate which gives the copper salt of diethyldithiocarbamic acid. The golden brown color formed is read colorimetrically at 440nm. The method is sensitive and unaffected by pH over the range of 5.7 to 9.2. By using the standard curve calculating the amount of copper in the sample and express the results as mg/100g of sample taking dilution factor into consideration.

2.2.6 Estimation of phosphorus

Phosphorus can be determined by the method described by (Piper, 1950)[13]. The dried sample ash using a carbonate-nitrate fusion mixture and the ash extracted with TCA. An acid molybdate solution and 1,2,4- amino-napthol sulphuric acid reagent. A blue colour, the intensity of which is proportional to the phosphorous content is produced. The intensity of the colour is read photo-metrically at 660nm.

2.3 Proximate analysis for sample one and two

2.3.1 Estimation of total solid

The total solids content was determine by gravimetric method as per IS: 1479 (part- II), 1961[7].

$$\text{Total Solid (\%)} = \frac{\text{Weight of residue}}{\text{Weight of sample}} \times 100$$

2.3.2 Estimation of moisture

Moisture content in the sample was determine by subtracting the total solids content from 100 in the sample[16].

Moisture (%) = 100 - total solids (%)

2.3.3 Estimation of total ash

The ash percentage was determine as per the method recommended in B.I.S Handbook of food analysis IS: 1165, (1967)[5].

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Original weight of sample}} \times 100$$

2.3.4 Estimation of total fat

The fat content was determine by Gerber method as described in IS: 1224 (part-I), 1977[6].

2.3.5 Estimation of protein

The protein percentage of millet was determine by estimating the per cent nitrogen by Micro-Kjeldhal method as recommended in IS: 1479 (part II), 1961[8].

$$\text{Nitrogen (\%)} = \frac{(A - B) \times 0.0014}{W} \times 100$$

Where,
A = Volume in ml N/10 NaOH in blank determination
B = Volume in ml of N/10 NaOH in the rest
W = Weight in mg of sample taken
The protein per cent was calculated by multiplying nitrogen percentage with factor 6.25.

$$\text{Protein (\%)} = \text{Percent total nitrogen} \times 6.25$$

2.3.6 Estimation of Crude Fiber

The fiber content was determine by Calculating crude fibre on dry wt. basis by giving correction for the moisture content[11].

$$\text{Crude fiber \% by wt} = \frac{W1 - W2}{W} \times 100$$

Where,
W_1 = wt in gm of Gooch crucible and contents before ashing.
W_2 = wt in gm of Gooch crucible containing asbestos and ash.
W = wt in gm of the dried material taken for the test.

2.3.7 Estimation of carbohydrate

Carbohydrate content in sample is estimated by subtractions method i.e.[16].

Carbohydrate = Total Solids - (Fat + Protein + Ash)

3. Results and Discussion

The results of chemical composition of finger millet is presented in table no. 1 as follow ; The calcium content in sample of Nashik region (363.87 ± 22.45) is higher than the Kolhapur region (362.28 ± 16.68) due to geographical differentiation reported by (Nazni and Bhuvaneswari, 2015)[10] i.e. calcium content in finger millet was (332±9.77). According to IIMR report the value of calcium content in finger millet sample was (361 ± 58). The magnesium content in sample of Nashik region (96.0 ± 0.78) is lesser than the Kolhapur region (96.03 ± 0.94) but results finding by (Verma and Patel, 2012)[18], as reported magnesium content in finger millet (130mg). Further IIMR report the value of magnesium content in Finger millet was (96.03 ± 0.94). The iron content in sample of Nashik region (5.02 ± 0.12) is higher than the Kolhapur region (4.78 ± 0.43), results finding by (Gull, 2014)[4] as reported Iron content in finger millet (6.3mg). According to IIMR report the value of Iron content in finger millet sample was (4.62 ± 0.36). The zinc content in sample of Nashik region (1.74 ± 0.96) is higher than the Kolhapur region (1.46 ± 0.79), but the IIMR reported content in finger millet is (1.67 ± 0.47). The Phosphorous content in sample of Nashik region (280.0 ± 9.78) is lesser than the Kolhapur region (282.34 ± 7.64) due to geographical differentiation reported by (Nazni and Bhuvaneswari, 2015) [10] was similar to IIMR report those values are (285 ± 8.39) and (285.47 ± 6.10). Among the other millet's finger millet content more amount of essential mineral such as calcium and phosphorus having high content compare to other like little millet, barnyard millet.

Table No. 1 Chemical composition of Finger millet (*Eleusine coracana*) (mg/100g sample)

Mineral	Sample no.1 (*Nashik* region)	Sample no.2 (*Kolhapur* region)	*IIMR report
Calcium (Ca)	363.87 ± 22.45	362.28 ± 16.68	361 ± 58
Magnesium(Mg)	96.0 ± 0.78	97.04 ± 0.36	96.03 ± 0.94
Iron (Fe)	5.02 ± 0.12	4.78 ± 0.43	4.62 ± 0.36
Zinc (Zn)	1.74 ± 0.96	1.46 ± 0.79	1.67 ± 0.47
Copper (Cu)	1.60 ± 0.09	0.98 ± 0.41	0.67 ± 0.22
Phosphorous (P)	280.0 ± 9.78	282.34 ± 7.64	285.47 ± 6.10

*IIMR : Indian Institute of Millets Research, Hyderabad[14]

Table No. 2 Proximate analysis of Finger millet (*Eleusine coracana*)

Characteristics	Sample no.1 (*Nashik* region)	Sample no.2 (*Kolhapur* region)	*IIMR report
pH (1% solution)	6.21	5.93	6.54
Total ash (g)	2.56 ± 0.28	2.24 ± 0.45	2.04 ± 0.34
Total triable acidity	0.20 ± 0.018	0.28 ± 0.071	0.24 ± 0.046
Crude Protein (g)	10.96 ± 0.520	5.78 ± 0.894	7.16 ± 0.630
Crude Fiber (g)	5.45 ± 1.26	8.56 ± 2.17	11.18 ± 1.14
Carbohydrates (g)	72.48 ± 0.48	64.96 ± 0.81	66.82 ± 0.73
Energy (k.Cal)	347.03 ± 10	318 ± 15	320.74 ± 21

*IIMR : Indian Institute of Millets Research, Hyderabad[14]

The results of proximate analysis of Finger millet is presented in table no.2 as follows ; The pH (1% solution) of sample one is (6.21) and sample two is (5.93), as per reported IIMR pH (1% solution) is (6.54). Total ash contain in sample one is (2.56 ± 0.28) and sample two is (2.24 ± 0.45), (Nazni and Bhuvaneswari, 2015)[14] was report the value (2.4 ± 0.07). But according to IIMR report the total ash contain was (2.04 ± 0.34). Total triable acidity of sample one is (0.20 ± 0.018) higher than sample two (0.28 ± 0.071). Results finding by IIMR reported it content (0.24 ± 0.046).The crude protein content in sample one is (10.96 ± 0.520) higher than the sample two (5.78 ± 0.894). Result finding by (Audu and Aremu, 2018)[1] as reported the content present in finger millet flour was (8.42 ± 0.05). But according to IIMR report the value of crude protein content in finger millet was (7.16 ± 0.630). Finger millet could therefore be used as an alternative source of protein in diets/protein supplement especially in nations like Nigeria where the majority of the populace live on starch food & cereals. Crude fiber content in sample one (5.45 ± 1.26) less than sample two (8.56 ± 2.17). Results finding by (Verma and Patel, 2012)[18] and (Gull, 2014)[4] i.e. crude fiber content in finger millet was (3.6). According to IIMR report the value of crude fiber was (11.18 ± 1.14). This suggests that finger millet could provide additional dietary fiber in the diet. The carbohydrate contain in sample one is (72.48 ± 0.48) higher than sample two (64.96 ± 0.81).

Result finding by (Verma and Patel ,2012)[18] as reported the content present in finger millet was (72.6), it is a major source of dietary carbohydrate for a large section of society belonging to millet growing areas. According to IIMR report the value of carbohydrate content in finger millet sample was (66.82 ± 0.73). The energy contain present in sample one is (347.03 ± 10) and sample two is (318 ± 15), According to IIMR report the energy content was (320.74 ± 21).

4. Conclusion

The above results shows that the effect of different parameters such as soil, geographical area, rainfall, climate of two different regions directly or indirectly affect on the proximate composition of finger millet. Not more difference observed between the two sample millet's. So the sample one (Nashik) region content **Ca** (**363.87± 22.45**), Mg (96.0± 0.78), Fe (5.02± 0.12), Zn (1.74± 0.96), Cu (1.60± 0.09), **P** (**280.0± 9.78**) and crude protein (10.96 ± 0.520), crude fiber (5.45 ± 1.26), carbohydrate (72.48 ± 0.48), energy (347.03 ± 10). The sample two (Kolhapur) region **Ca** (**362.28± 16.68**), Mg (97.04± 0.36), Fe (4.78± 0.43), Zn (1.46± 0.79), Cu (0.98± 0.41), **P** (**282.34± 7.64**) and crude protein (5.78 ± 0.894), crude fiber (8.56 ± 2.17), carbohydrate (64.96 ± 0.81), energy (318 ± 15). Due to presence of large amount of calcium, phosphorous, protein and carbohydrate millet's can be used in food similarly pharmaceutical industry for making good products.

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